

CLAIMS

WHAT IS CLAIMED IS:

1. A support structure for being disposed within an outer containment comprising:
 - a center;
 - at least two branched segments oriented about the center and encompassed by an outer perimeter; wherein each branched segment includes:
 - a plurality of struts; each strut having a proximal end and a distal end; the distal end of each strut extending to the perimeter;
 - wherein the proximal end of one strut is connected to the center and each consecutive strut is connected to the previous strut at the proximal end of the consecutive strut such that alternate consecutive struts are substantially parallel to each other.
2. The support structure of claim 1 wherein a distance defined between alternate consecutive struts is substantially constant.
3. The support structure of claim 1 wherein at least one consecutive strut of one branched segment is parallel to at least one consecutive strut of another branched segment.
4. The support structure of claim 1 wherein the outer perimeter substantially defines a circle.
5. The support structure of claim 1 wherein the at least one strut is substantially radial.
6. The support structure of claim 1 wherein the at least one strut includes at least one bend.
7. The support structure of claim 1 wherein at least one consecutive strut is straight.
8. The support structure of claim 1 wherein at least one consecutive strut includes at least one bend.
9. The support structure of claim 1 wherein each consecutive strut is connected to the previous strut at a distance from the proximal end of the previous strut.

10. The support structure of claim 9 wherein the distance is constant.
11. The support structure of claim 1 wherein each strut is adapted to react a load in an axial direction.
12. The support structure of claim 1 wherein at least one strut includes an elbow.
13. The support structure of claim 1 wherein the at least one strut includes an elbow such that its distal end is substantially perpendicular to the perimeter.
14. The support structure of claim 1 wherein each consecutive strut is connected to the previous strut at an angle located between the distal end of the previous strut and the distal end of the consecutive strut.
15. The support structure of claim 14 wherein the angle is constant throughout the branched segment.
16. The support structure of claim 1 wherein the center is located substantially at the center of the perimeter.
17. The support structure of claim 1 wherein the center is a hub.
18. The support structure of claim 17 wherein the hub is adapted to receive a spindle for transferring a load.
19. The support structure of claim 17 wherein the hub is adapted to transfer a load to a second support structure located upstream.
20. The support structure of claim 1 wherein at least one strut is corrugated.
21. The support structure of claim 20 wherein the at least one corrugated strut is connected to the center.
22. The support structure of claim 20 wherein the at least one corrugated strut is connected to another strut.
23. The support structure of claim 20 wherein the consecutive struts connected to the corrugated strut are connected with lap joints.
24. The support structure of claim 20 wherein at least one consecutive strut is connected to the previous strut with a lap joint.
25. The support structure of claim 1 wherein the one strut is connected to the center with a slip joint.

26. The support structure of claim 25 wherein the proximal end of the one strut connected to the center includes at least one tongue; the center includes at least one slot adapted to receive the at least one tongue.

27. The support structure of claim 1 wherein at least one consecutive strut is connected to the previous strut with a slip joint.

28. The support structure of claim 27 wherein the previous strut includes at least one slot and the proximal end of the at least one consecutive strut includes at least one tongue, the tongue of the at least one consecutive strut being received in the slot of the previous strut.

29. The support structure of claim 1 further including an outer ring encompassing the branched segments.

30. The support structure of claim 29 wherein the outer ring includes a plurality of peaks and troughs formed substantially in the radial direction.

31. The support structure of claim 30 wherein the distal ends are connected to the outer ring at the troughs.

32. The support structure of claim 29 wherein the one strut connected to the center or at least one consecutive strut is coupled to the outer ring with a slip joint.

33. The support structure of claim 1 wherein the distal end of at least one strut includes a flange.

34. The support structure of claim 33 further including an outer ring having an expansion slot, the flange being received within the expansion slot such that the at least one strut is retained yet substantially free to move in a radial direction within the expansion slot.

35. The support structure of claim 1 wherein the distal end of at least one strut includes at least two notches to form a T-end.

36. The support structure of claim 35 further including an outer ring having an expansion slot, the T-end being received within the expansion slot such that the strut is retained yet substantially free to move in a radial direction within the expansion slot.

37. The support structure of claim 1 wherein the distal end of at least one strut includes a slot.

38. The support structure of claim 37 further including an outer ring passed through the slot such that the distal end is retained yet substantially free to move in a radial direction.

39. The support structure of claim 1 wherein the at least one strut is connected to the center with at least a braze lug.

40. The support structure of claim 1 wherein the at least one consecutive strut is connected to the previous strut with at least a braze lug.

41. The support structure of claim 39 or 40 wherein the braze lug includes at least two flanges, a strut receiving portion coupled to the at least two flanges, at least two tabs coupled to the at least two flanges, and at least one tab couple to the strut receiving portion.

42. The support structure of claim 1 wherein at least a portion of the distal ends are connected to the outer containment.

43. The support structure of claim 42 wherein the at least a portion of the distal ends are connected to the outer containment with a slip joint.

44. The support structure of claim 1 wherein each of the at least a portion of the distal ends includes a flange.

45. The support structure of claim 44 wherein the outer containment includes an expansion slot, the flange being received within the expansion slot such that it is retained yet substantially free to move in a radial direction within the expansion slot.

46. The support structure of claim 1 wherein each of the at least a portion of distal ends includes at least two notches to form a T-end.

47. The support structure of claim 46 wherein the outer containment includes an expansion slot, the T-end being received within the expansion slot such that it is retained yet substantially free to move in a radial direction within the expansion slot.

48. A support structure comprising:

a center;

at least three branched segments oriented about the center and encompassed by a perimeter; each branched segment comprising:

a primary strut having a proximal end and a distal end; the primary strut having an intersection with the center at the proximal end and extending to the perimeter at the distal end;

a plurality of secondary struts; each secondary strut having a proximal end and at least one distal end; each secondary strut having an intersection with the primary strut at the proximal end of the secondary strut and extending to the perimeter at the distal end of the secondary strut.

49. The support structure of claim 48 wherein the outer perimeter substantially defines a circle.

50. The support structure of claim 48 wherein the center is located substantially at the center of the perimeter.

51. The support structure of claim 48 wherein the primary strut is substantially radial.

52. The support structure of claim 48 wherein the primary strut includes at least one bend.

53. The support structure of claim 48 wherein at least one secondary strut is straight.

54. The support structure of claim 48 wherein at least one secondary strut includes at least one bend.

55. The support structure of claim 48 wherein intersections of the secondary struts with the primary strut along the primary strut are substantially equally spaced.

56. The support structure of claim 48 wherein at least one secondary strut includes an elbow.

57. The support structure of claim 48 wherein the at least one secondary strut includes an elbow such that its distal end is substantially perpendicular to the perimeter.

58. The support structure of claim 48 wherein the primary strut includes an elbow.

59. The support structure of claim 48 wherein secondary struts define a distance between secondary struts that is substantially constant.

60. The support structure of claim 48 wherein adjacent secondary struts are substantially equally spaced.

61. The support structure of claim 48 wherein the primary strut includes a first side and a second side; and

wherein secondary struts extending from the first side of the primary strut are substantially parallel to each other and secondary struts extending from the second side of the primary strut are substantially parallel to each other.

62. The support structure of claim 61 wherein the primary strut is substantially parallel to at least one secondary strut of another branched segment.

63. The support structure of claim 48 wherein the center is a hub.
64. The support structure of claim 63 wherein the hub is adapted to receive a spindle for transferring a load.
65. The support structure of claim 63 wherein a load is transferred to a second support structure located upstream.
66. The support structure of claim 48 wherein the primary strut is corrugated.
67. The support structure of claim 66 wherein the intersection of each secondary strut with the primary strut is a lap joint.
68. The support structure of claim 48 wherein at least one secondary strut is corrugated.
69. The support structure of claim 68 wherein secondary struts connected to the corrugated secondary strut are connected with lap joints.
70. The support structure of claim 48 wherein the intersection of the primary strut with the center is a slip joint.
71. The support structure of claim 70 wherein the proximal end of the primary strut includes at least one tongue; the center includes at least one slot adapted to receive the at least one tongue.
72. The support structure of claim 48 wherein the intersection of each secondary strut with the primary strut is a slip joint.
73. The support structure of claim 72 wherein the primary strut includes at least one slot and the proximal end of the secondary strut includes at least one tongue, the tongue of the secondary strut being received in the slot of the primary strut.
74. The support structure of claim 72 wherein the primary strut includes at least one slot and the secondary strut is bent and includes at least two distal ends; the secondary strut being received in the slot of primary strut.
75. The support structure of claim 48 further including at least one primary strut that is located between branched segments.
76. The support structure of claim 75 wherein the at least one primary strut located between branched segments is substantially parallel to at least one secondary strut.
77. The support structure of claim 75 wherein the at least one primary strut located between branched segments is equally spaced from at least one secondary strut.

78. The support structure of claim 75 wherein at least one secondary strut and at least one primary strut that is located between branched segments define a distance between at least one secondary strut and at least one primary strut that is located between branched segments that is substantially constant.

79. The support structure of claim 48 further including an outer ring encompassing the branched segments.

80. The support structure of claim 79 wherein the outer ring includes a plurality of peaks and troughs.

81. The support structure of claim 80 wherein the distal ends of both primary and secondary struts are connected to the outer ring at the troughs formed substantially in a radial direction.

82. The support structure of claim 79 wherein at least one primary strut or at least one secondary strut is coupled to the outer ring via a slip joint.

83. The support structure of claim 48 wherein the distal end of at least one primary or at least one secondary strut includes a flange.

84. The support structure of claim 83 further including an outer ring having an expansion slot, the flange being received within the expansion slot such that the strut is retained yet free to move in a radial direction within the expansion slot.

85. The support structure of claim 48 wherein the distal end of either at least one primary or secondary strut includes at least two notches to form a T-end.

86. The support structure of claim 85 further including an outer ring having an expansion slot, the T-end being received within the expansion slot such that the strut is retained yet substantially free to move in a radial direction within the expansion slot.

87. The support structure of claim 48 wherein the distal end of either at least one primary or secondary strut includes at least one slot.

88. The support structure of claim 87 further including an outer ring passed through the slot such that the distal end is retained yet substantially free to move in a radial direction.

89. The support structure of claim 48 wherein the intersection of the primary strut with the center includes a braze lug.

90. The support structure of claim 89 wherein the braze lug includes at least two flanges, a strut receiving portion coupled to the at least two flanges, at least two tabs coupled to the at least two flanges, and at least one tab couple to the strut receiving portion.

91. A support structure comprising:

a center;

an outer ring encompassing the center;

a plurality of primary struts; each primary strut having a proximal end connected to the center and a distal end connected to the outer ring;

a plurality of cantilevered struts; each cantilevered strut having a distal end connected to the outer ring and a proximal end extending towards the center.

92. The support structure of claim 91 wherein at least one cantilevered strut is located between primary struts.

93. The support structure of claim 91 wherein the primary struts are substantially radial.

94. The support structure of claim 91 wherein the cantilevered struts are substantially radial.

95. The support structure of claim 91 wherein the center is a hub.

96. The support structure of claim 91 wherein the center is located substantially at the center of the outer ring.

97. A support structure comprising:

a center;

an outer ring encompassing the center;

a plurality of struts configured about the center; each strut of the plurality of struts having a proximal end and a distal end; each distal end being connected to the outer ring; a first portion of struts being connected to the center at their proximal ends;

wherein at least one strut that is connected to the outer ring is movably connected at the outer ring such that the distal end of the at least one strut is substantially free to move relative to the outer ring.

98. The support structure of claim 97 wherein each strut is adapted to react a load in an axial direction.

99. The support structure of claim 97 further including a second portion of struts; at least one strut of the second portion being connected at its proximal end to another strut such that the proximal end of the at least one strut of the second portion is substantially free to move relative to the another strut.

100. The support structure of claim 97 wherein at least one strut of the first portion is connected to the center such that the proximal end of the at least one strut of the first portion is substantially free to move relative to the center.

101. The support structure of claim 97 wherein the plurality of struts are configured into branched segments oriented about the center.

102. The support structure of claim 97 wherein the center is located substantially at the center of the outer ring.

103. The support structure of claim 97 wherein the outer ring includes an expansion slot.

104. The support structure of claim 103 wherein the expansion slot is formed by attaching a receiving portion to the outer ring.

105. The support structure of claim 104 wherein the outer ring includes an outer surface and a slot, the receiving portion being attached to an outer surface of the outer ring at the slot.

106. The support structure of claim 97 wherein the distal end of at least one strut connected to the outer ring includes a flange.

107. The support structure of claim 106 wherein the flange is movably retained within an expansion slot.

108. The support structure of claim 97 wherein the distal end of at least one strut connected to the outer ring includes at least two notches forming a T-end

109. The support structure of claim 108 wherein the T-end is movably retained within the expansion slot.

110. The support structure of claim 97 wherein the distal end of at least one strut connected to the outer ring includes at least one slot.

111. The support structure of claim 110 wherein the outer ring is passed through the slot such that the distal end is retained yet substantially free to move in a radial direction.

112. A support structure for being disposed within an outer containment comprising:

a center;

a plurality of struts configured about the center; each strut of the plurality of struts having a proximal end and a distal end; each distal end being connected to the outer containment; a first portion of struts being connected to the center at their proximal ends;

wherein at least one strut that is connected to the outer containment is movably connected to the outer containment such that the distal end of the at least one strut is substantially free to move relative to the outer containment.

113. The support structure of claim 112 wherein each strut is adapted to react a load in an axial direction.

114. The support structure of claim 112 further including a second portion of struts; at least one strut of the second portion being connected at its proximal end to another strut such that the proximal end of the at least one strut of the second portion is substantially free to move relative to the another strut.

115. The support structure of claim 112 wherein at least one strut of the first portion is connected to the center such that the proximal end of the at least one strut of the first portion is substantially free to move relative to the center.

116. The support structure of claim 112 wherein the plurality of struts are configured into branched segments oriented about the center.

117. The support structure of claim 112 wherein the center is located substantially at the center of the support structure.

118. The support structure of claim 112 wherein the outer containment includes an expansion slot.

119. The support structure of claim 118 wherein the expansion slot is formed by attaching a receiving portion to the outer containment.

120. The support structure of claim 119 wherein the outer containment includes an outer surface and a slot, the receiving portion being attached to an outer surface of the outer containment at the slot.

121. The support structure of claim 112 wherein the distal end of at least one strut connected to the outer containment includes a flange.

122. The support structure of claim 121 wherein the flange is movably retained within an expansion slot.

123. The support structure of claim 112 wherein the distal end of at least one strut connected to the outer containment includes at least two notches forming a T-end.

124. The support structure of claim 123 wherein the T-end is movably retained within an expansion slot.

125. The support structure of claim 112 wherein the distal end of at least one strut connected to the outer containment includes at least one slot.

126. The support structure of claim 125 wherein the distal end of at least one strut connected to the outer containment is connected at the slot such that the distal end is retained yet substantially free to move in a radial direction.

127. A support structure for being disposed within an outer containment comprising:

a center;

a plurality of struts configured about the center; each strut of the plurality of struts having a proximal end and a distal end; a first portion of struts being connected to the center at their proximal ends; a second portion of struts wherein each strut of the second portion is connected to another strut at its proximal end;

wherein at least one strut of the first portion is connected such that its proximal end is substantially free to move relative to the center; and at least one strut of the second portion is connected such that its proximal end is free to move relative to the another strut.

128. The support structure of claim 127 further including an outer ring; the distal ends are connected to the outer ring.

129. The support structure of claim 127 wherein at least one strut is connected at its distal end to the outer ring such that the distal end of the at least one strut is substantially free to move with respect to the outer ring.

130. The support structure of claim 127 wherein distal ends are connected to the outer containment.

131. The support structure of claim 127 wherein at least one strut is connected at its distal end to the outer containment such that the distal end of the at least one strut is substantially free to move with respect to the outer containment.

132. The support structure of claim 127 wherein the plurality of struts are configured into branched segments oriented about the center.

133. A support structure for a catalyst comprising:

a center;

a plurality of struts configured into branched segments about the center;

wherein the distance between adjacent struts provides a substantially uniform contact stress with respect to a substantial portion of the catalyst.

134. A support structure comprising:

a center;

a plurality of struts; each strut having a proximal end and a distal end; the plurality of struts being configured about the center such that each strut is substantially free to expand or to contract at its distal or proximal end as temperature changes.

135. The support structure of claim 134 wherein the plurality of struts is configured into at least two branched segments oriented about the center.

136. The support structure of claim 135 further including a perimeter encompassing the plurality of struts;

wherein each branched segment includes:

a primary strut having a proximal end and a distal end; the proximal end of the primary strut having an intersection with the center; the primary strut extending to the perimeter at its distal end;

a plurality of secondary struts; each secondary strut having a proximal end and a distal end; the proximal end of each secondary strut having an intersection with the primary strut and extending to the perimeter at the distal end of each secondary strut.

137. A support structure comprising:

a center;

an outer perimeter encompassing the center;

a plurality of struts forming at least two branched segments oriented about the center; wherein each branched segment includes:

a first strut having a proximal end and a distal end; the proximal end of the first strut being connected to the center and extending to the perimeter at its distal end;

at least a second strut having a proximal end and a distal end; the proximal end of the second strut being connected to the first strut and extending to the perimeter at its distal end.

138. The support structure of claim 137, further including

a third strut having a proximal end and a distal end; the proximal end of the third strut being connected to the second strut such that the third strut is substantially parallel to the first strut and spaced a distance from the first strut; the third strut extends to the perimeter at its distal end.

139. The support structure of claim 138 further including

a fourth strut having a proximal end and a distal end; the proximal end of the fourth strut being connected to the third strut such that the fourth strut is substantially parallel to the second strut and spaced a distance from the second strut; the fourth strut extends to the perimeter at its distal end.

140. The support structure of claim 139 further including

a fifth strut having a proximal end and a distal end; the proximal end of the fifth strut being connected to the fourth strut such that the fifth strut is substantially parallel to the third strut and spaced a distance from the third strut; the fifth strut extends to the perimeter at its distal end.

141. The support structure of claim 140 further including

a sixth strut having a proximal end and a distal end; the proximal end of the sixth strut being connected to the fifth strut such that the sixth strut is substantially parallel to the fourth strut and spaced a distance from the fourth strut; the sixth strut extends to the perimeter at its distal end.

142. The support structure of claim 141 further including

at least a seventh strut having a proximal end and a distal end; the proximal end of the seventh strut being connected to the sixth strut such that the seventh strut is substantially parallel to the fifth and spaced a distance from the fifth strut; the seventh strut extends to the perimeter at its distal end.

143. The support structure of claim 137 wherein the distance is approximately constant.

144. The support structure of claim 137 wherein the center is located at substantially the center of the support structure.